

climates of the one-fourth of the earth that is land. A study of motions of the deep currents in the sea, such as the vast exchange of polar water masses with those of warmer oceans, is necessary for long-range weather forecasting. Changes of sea level and tidal motions provide information about currents and give important indications of significant weather trends, such as periods of gradual warming up of the entire world.

The objectives of the oceanographic program are twofold. The first objective is to measure the motion of the waters at depths in the ocean. Practically nothing is known about ocean currents except at the very surface of the sea. So little is known about the circulation of the ocean that nobody knows whether it takes 100 years or 10,000 years for the deep water to travel from the Antarctic up to the Equator and back again.

Why should we try to learn more about the deep ocean currents? There are three reasons: First, the deep currents may be of great importance in long-range weather forecasting, particularly because of the exchange of water between the Antarctic and low latitudes. Second, the fertility of the ocean depends upon the exchange of water between the deeps and the waters near the surface; that is, the amount of fish and other food we can get out of the ocean is finally limited by the rate at which the ocean overturns and thereby fertilizes itself. In order to get some estimate of what the potential food supply from the ocean is, and to learn how we can do something about it, we have to know about the deep currents. Third, the development of peaceful uses of atomic energy will probably result in the production of unbelievable quantities of radioactive substances, and somehow these must be safely disposed of. One possible thing to do with them is to dump them into the deep sea: the ocean is a very great hole in the ground, and its currents might spread out radioactive substances to such an extent that they would be harmless. Whether this would be possible or not depends on how fast the deep water moves or how it mixes with the waters near the surface. This information is now unknown.

For all these reasons, the deep water circulation of the oceans will be one of the major subjects of investigation of the great series of oceanographic expeditions that will be sent out during the International Geophysical Year by many different countries. At the same time, considerable effort will be expended to find out about the shape of the deep-sea floor and about the interior of the earth. This knowledge is needed to understand such things as the distribution of mineral deposits.

The other part of the oceanographic program calls for a continuous record of the changes in sea level over the course of the year at island stations in all the oceans. The sea level changes with the season: in summer and autumn it is about a foot higher on the average than in winter and spring. This change in sea level is undoubtedly due in part at least to the transport of water by the great ocean currents. If the water goes up in one area and goes down in another, some water must go from one region to the other. Here at last we may have an inexpensive means, using observing points on land, of measuring the changing motions of the oceans. An attempt will be made during the International Geophysical Year to measure sea level at some hundred newly established stations in addition to the tide gage stations already